Using NASA Earth Observations and SAR to Enhance Crop Classification Accuracy from Ground Surveys to Larger Scales in the Long Term Agroecosystem Research (LTAR) Network

Abstract

North Dakota and Georgia are two of the largest commercial agricultural producers in the United States, with a combined crop value of over 11 billion dollars (USD). Agriculture management and sustainability practices—such as irrigation patterns and plant and harvest strategies—are crucial to long-term food security. Crop classification improves agriculture management decisions by distinguishing between different crop types and providing information on the climatic requirements, productivity, and environmental impact of each. This project collaborated with the USDA Agricultural Research Service (ARS) to evaluate the effectiveness of an integrated remote sensing approach to crop classification. The team compared multispectral Landsat 8 Operational Land Imager (OLI), Sentinel-1 C-Band Synthetic Aperture Radar (C-SAR), and Sentinel-2 MultiSpectral Instrument (MSI) data from the 2016-2017 growing seasons in North Dakota. *In situ* crop field data from ARS were used to test and calibrate the accuracy of the crop classification maps. The inclusion of radar in classification allowed for more precise and active monitoring in these crucial crop areas. Going forward, the ARS can advance crop classification methods and sensors to support larger study areas.

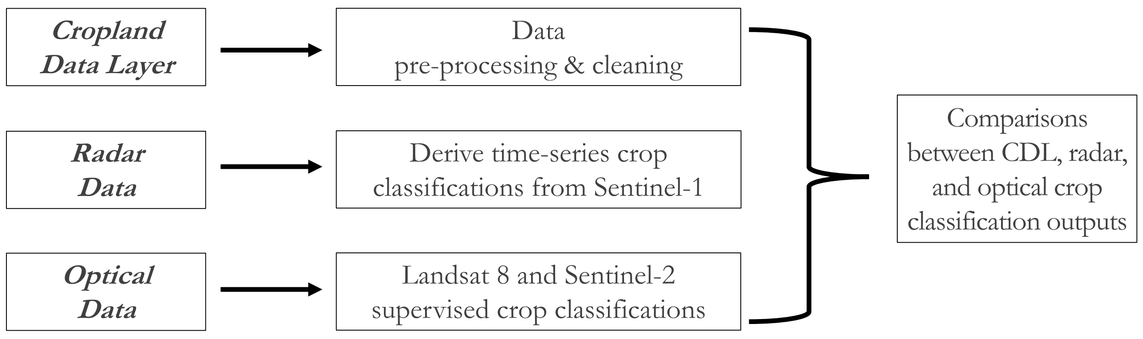
Objectives

- **Assess** the feasibility of using SAR date from Sentinel-1 as a complement to optical data in the creation of crop classification maps
- **Compare** SAR classification to Landsat 8, Sentinel-2, and the Cropland Data Layer (CDL) classifications for the same study area and time period for validation and accuracy assessment

Study Area

Fig. 1: Study area map and inset depicting the extent of the fields of interest at the Northern Great Plains Research Laboratory LTAR location in Mandan, North Dakota

Methodology



Project Partners

- USDA Agricultural Research Service
- USDA National Agricultural Statistics Service

Results

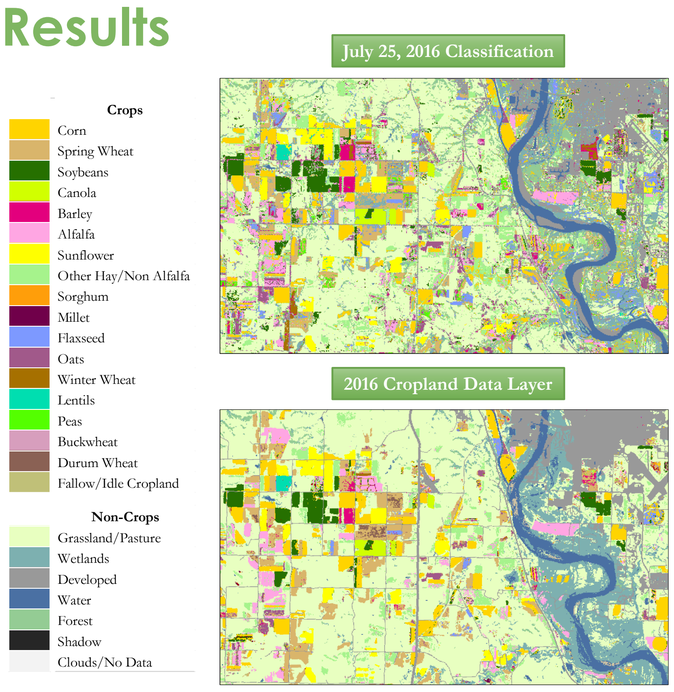
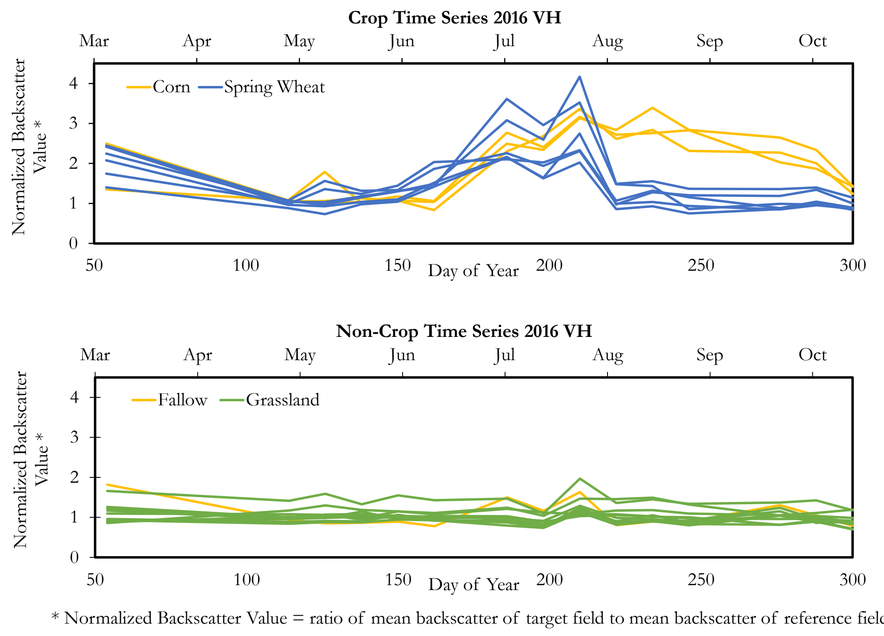


Fig. 2: Landsat 8 optical random tree crop classification from 7/25/2016 (top) and the 2016 USDA Cropland Data Layer (bottom)



* Normalized Backscatter Value = ratio of mean backscatter of target field to mean backscatter of reference field

Fig. 3: Time series over the 2016 growing season of select crop (top) and non-crop (bottom) fields showing normalized backscatter values from VH Sentinel-1 images

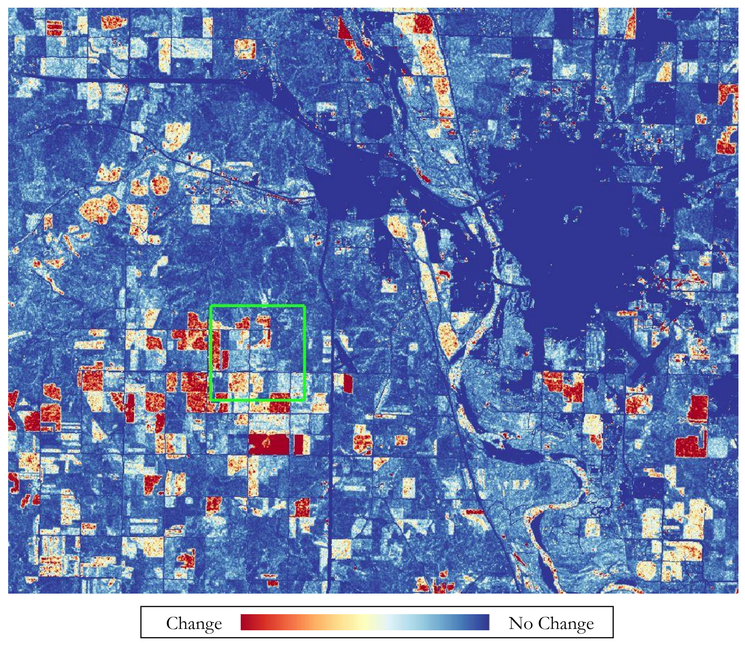
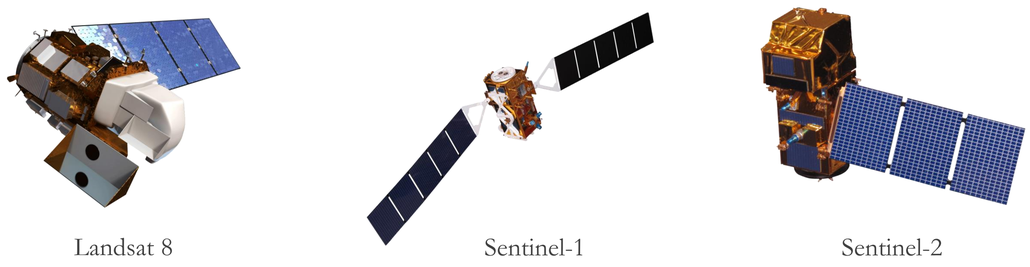


Fig. 4: Coefficient of variation image of 2016 Sentinel-1 data distinguishing between areas of high change to low change

Earth Observations



Landsat 8 | Sentinel-1 | Sentinel-2

Conclusions

- Radar data from Sentinel-1 can be used to decipher crop and non-crop areas in North Dakota and can be further explored for the Georgia study area in a future term.
- Error was introduced in the Landsat 8 and Sentinel-2 classifications as a result of consistent cloud cover over the study area.
- More *in situ* field data are necessary to create a wider array of crop-type training polygons for each satellite classification to better validate the CDL.

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